IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of:	)	
Hidetoshi **ISHIDA** et al.	)	Confirmation No.: 9493
Application No.: 09/707,844	)	Examiner: David A. Zarneke
Filed: November 8, 2000	)	Art Unit: 2891
For: RADIO FREQUENCY SIGNAL PROCESSING	)	

MAIL STOP APPEAL BRIEF – PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

APPEAL BRIEF

In support of the Notice of Appeal filed February 21, 2008, and further to Board Rule 41.37.

This Appeal responds to the November 21, 2007, final rejection of claims 11-21. Appellants respectfully request that the Board of Patent Appeals and Interferences reverse the final rejection of these claims.

If any additional fees are required or if the enclosed payment is insufficient, Appellant requests that the required fees be charged to Deposit Account No. 19-2380.

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I. REAL PARTY IN INTEREST

Matsushita Electric Industrial Co., is the assignee and real party in interest.

II. RELATED APPEALS AND INTERFERENCES

At present, there are no related appeals or interferences known to the Appellants, the Appellants' representative or the assignee, which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-10 have been canceled without prejudice or disclaimer.

Claims 11-21 stand finally rejected and are the subject of this Appeal.

IV. STATUS OF AMENDMENTS

No amendment has been filed or submitted after the Final Office Action mailed November 21, 2007.

V. SUMMARY OF CLAIMED SUBJECT MATTER

This Appeal is taken from claims 11-21, of which claims 11 and 15 are independent.

The present invention relates to an RF device (15) which includes a semiconductor substrate (1); first and second semiconductor components (2, 3) provided on the substrate (1). Each of the components (2, 3) includes source electrodes (5), a gate electrode (6) and a drain electrode (7) and multiple through holes (8, 9), which pass through the substrate (1) in the thickness direction, and are opened in a region of the substrate (1) between the two components (2, 3). To enhance the effect of suppressing electrical interference between the components (2, 3), a gap (g) between two adjacent ones of the through holes (8, 9) is preferably smaller than the thickness (d) of the substrate (1).

The foregoing features are broadly encompassed in each of Appellant's independent claims 11 and 15 as follows:

Independent Claim 11

Independent claim 11 relates to an RF device (15) comprising: a plurality of semiconductor elements (2, 3) formed on a semiconductor substrate (1) composed of a semiconductor material; a plurality of through holes (9) which are provided between two adjacent ones of the plurality of semiconductor elements (2, 3) and pass from a surface through the backside of the semiconductor substrate (1), wherein a distance (g) between two adjacent ones of the plurality of through holes (9) is smaller than a thickness (d) of the semiconductor substrate (1) so as to reduce power leaking between two adjacent ones of the plurality of semiconductor elements (2, 3).

Support for claim 11 can be found, for example, at least in FIGS. 1(a) to 1(c) and the description of the present specification at page 6, line 14 through page 8, line 18.

Independent Claim 15

Independent claim 15 relates to an RF device (15) comprising: a plurality of semiconductor elements (2, 3) formed on a semiconductor substrate (1) composed of a semiconductor material; a first group of through holes (9) which are provided between two adjacent ones of the plurality of semiconductor elements (2, 3) and pass from a surface through the backside of the semiconductor substrate (1) and whose side faces are covered with a conductive material (10); and a second group of through holes (8) which are provided in electrodes (5) of the plurality of semiconductor elements (2, 3), pass from a surface through the backside of the semiconductor substrate (1), and whose side faces are covered with the conductive material (10), wherein the conductive material (10) which covers side faces of the first and second groups of through holes (8) is electrically connected to a first wiring layer (11) provided on the backside of the semiconductor substrate (1), and a distance (g) between two adjacent ones of the first group of through holes (9) is smaller than a thickness (d) of the semiconductor substrate (1) so as to reduce power leaking between two adjacent ones of the plurality of semiconductor elements (2, 3).

Support for claim 15 can be found, for example, at least in FIGS. 4(a) to 4(c) and the description of the present specification at page 10, line 14 through page 13, line 11.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The grounds of rejection to be reviewed on appeal are as follows:

Claims 11-14, 17 and 18 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Inoue (U.S. Patent No. 5,151,770 – hereafter Inoue).

Claims 15, 16 and 19-21 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Inoue as applied to claims 11-14 above, and further in view of Nakamura et al. (U.S. Patent No. 6,229,209 – hereafter Nakamura).

VII. ARGUMENTS

The Rejection under 35 U.S.C. § 103(a) should be Reversed

Claims 11-14, 17 and 18 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Inoue. Claims 15, 16 and 19-21 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Inoue as applied to claims 11-14 above, and further in view of Nakamura. Appellants appeal this rejection and request reversal for at least the reasons set forth hereinbelow.

Initially, it is unclear to the Applicants how Inoue alone teaches the features of claim 18 which depends on independent claim 15. Perhaps the Examiner intended to group claim 18 with the combination of Inoue and Nakamura mentioned above.

Each of the claims recite a specific combination of features that distinguishes the invention from the prior art in different ways. At the very least, the applied references, whether taken alone or in combination, fail to disclose or suggest any of these exemplary features recited, for example, in independent claims 11 and 15.

Independent claim 11

Regarding claim **11** as shown, for example, in FIGS 1(a) to 1(c), claim 11 recites an RF device (15) comprising: a plurality of semiconductor elements (2, 3) formed on a semiconductor substrate (1) composed of a semiconductor material; a plurality of through holes (9) which are provided between two adjacent ones of the plurality of semiconductor elements (2, 3) and pass from a surface through the backside of the semiconductor substrate (1), wherein a distance (g) between two adjacent ones of the plurality of through holes (9) is smaller than a thickness (d) of the semiconductor substrate (1) so as to reduce power leaking between two adjacent ones of the plurality of semiconductor elements (2, 3). That is, a particular feature of the RF device recited in independent claim 11 resides not only in the fact that the distance between the two adjacent through holes is smaller than the thickness of the semiconductor substrate so as to reduce power leakage between two adjacent semiconductor elements, but also that the device includes a plurality of semiconductor elements formed on a semiconductor substrate composed of a semiconductor material. In accordance with Applicants' claimed invention, such a feature improves the isolation between the two semiconductor elements devices having through holes therebetween with respect to the radio frequency signal.

Turning to the cited prior art rejection of the final Office Action dated November 21, 2007, Inoue, (according to figures 1 and 5, and col. 9, lines 29-32 and col. 4, lines 1-5) discloses: a semiconductor device comprising: a plurality of semiconductor elements 24 and 26, formed on a semiconductor substrate 21, 27 composed of a semiconductor material; and a plurality of through holes, which are provided between two adjacent ones of the plurality of semiconductor elements and pass from a surface through the backside of the semiconductor substrate, which is GaAs. The Examiner admits that Inoue does not expressly disclose a distance between two adjacent ones of the plurality of through holes is smaller than a thickness of semiconductor substrate. However, the Examiner asserts that Inoue discloses that the through holes having spacing substantially less than a wavelength of the operating frequency of the circuits in the layer which the through holes are located. Inoue discloses setting the distance between two adjacent through holes to 100 μm and using GaAs as a substrate, and further discloses that the sum of a thickness of the substrate and a thickness of

an insulating layer is larger than the distance between the through holes. However, the thickness of the substrate taught in Inoue includes a thickness of the insulating layer formed on the substrate, *i.e.*, 500 μm plus a thickness of the substrate 21. Therefore, the thickness in Inoue is not a thickness of the substrate 21 alone. Since Inoue does not disclose or suggest a thickness of the substrate 21, the structural relationship between the through holes and the thickness of the substrate is not known by the teachings of Inoue directly or indirectly.

Furthermore, a principal objective of Inoue is to form its through holes in the insulating layer. In general, it is well known that insulating layers have a smaller dielectric constant than semiconductor substrates; therefore, RF signals propagate more to the semiconductor substrate than to the insulating layer taught in Inoue. It should be noted that generally electromagnetic waves tend to pass through the areas where the dielectric constant is high. Even if the through holes are formed in the insulating layer at a short distance between themselves, the structural relationship between the distance between the through holes and the thickness of the substrate is not taught by Inoue given that Inoue fails to disclose a thickness of the substrate alone. Thus, it cannot be said that the structure of Inoue "further insulates the integrated circuits of the substrate from RF interfering," as asserted by the Examiner.

The Examiner further asserts that Inoue discloses the features of "through holes having spacing substantially less than a wavelength of the operating frequency of the circuits in the layer which the through holes are located" and that "it would have be obvious to one of ordinary skill in the art at the time of the invention to make the distance between the through holes smaller than the thickness of the substrate ..." (last paragraph on page 2 of the Office Action). However, Applicants contend that if the frequency of the circuits is set to 1 to 60 GHz, which is a range often adopted by those skilled in the art, the operating frequency of the circuits will become 5 to 300 mm, which is much greater than 500 μm, the disclosed thickness of the insulation layer in Inoue. In other words, it would be obvious to those skilled in the art that the operating frequency of the circuits is greater than the thickness of the substrate without having to rely upon any teachings of Inoue.

In contrast, the present invention does not look to the operating frequency of the circuits being greater than the thickness of the substrate, but rather looks to the structural relationship between the substrate thickness and the distance between two adjacent through holes, *i.e.*, making the distance between the adjacent through holes smaller than the substrate thickness, when improving isolation between two adjacent semiconductor elements. This feature is not taught or suggested by the disclosed features or structure of Inoue. Thus, it cannot be said that Inoue makes the present invention obvious as recited in independent claim 11.

Dependent claims 12-14 and 17

Claims 12-14 and 17 depend from claim 11, and therefore include the combinations the features set forth in their respective independent claims. For at least this reason, the rejection of these dependent claims also should be reversed. Additionally, the dependent claims recite combinations of features including additional subject matter not taught or suggested by Inoue. However, because the distinctions pointed out above are clear, Appellants will not belabor at this time a detailed discussion of separately patentable subject matter set forth in the dependent claims.

Independent claim 15

Regarding claim **15**, for example, as shown in FIGS. 4(a) to 4(c) claim 15 recites an RF device (15) comprising: a plurality of semiconductor elements (2, 3) formed on a semiconductor substrate (1) composed of a semiconductor material; a first group of through holes (9) which are provided between two adjacent ones of the plurality of semiconductor elements (2, 3) and pass from a surface through the backside of the semiconductor substrate (1) and whose side faces are covered with a conductive material (10); and a second group of through holes (8) which are provided in electrodes (5) of the plurality of semiconductor elements (2, 3), pass from a surface through the backside of the semiconductor substrate (1), and whose side faces are covered with the conductive material (10), wherein the conductive material (10) which covers side faces of the first and second groups of through holes (8) is electrically connected to a first wiring layer (11) provided on the backside of the

semiconductor substrate (1), and a distance (g) between two adjacent ones of the first group of through holes (9) is smaller than a thickness (d) of the semiconductor substrate (1) so as to reduce power leaking between two adjacent ones of the plurality of semiconductor elements (2, 3). In other words, through holes for shielding and through holes for electrodes of a semiconductor device are simultaneously formed and making a distance between two adjacent through holes smaller than a thickness of the semiconductor substrate so as to reduce power leaking between two adjacent semiconductor elements are disclosed. These features and structure greatly improve isolation of the two semiconductor elements, having through holes therebetween with respect to radio frequency (RF) signals.

According to figure 1, and col. 6, lines 4-19, Nakamura discloses a second group of through holes (23) which are provided in electrodes of the semiconductor element (3), pass from a surface through the backside of the substrate (20), and whose faces are covered with conductive material (24). However, as readily admitted by the Examiner, Inoue does not expressly disclose a second group of through holes which are provided in electrodes of the plurality of semiconductor elements, pass from a surface through the backside of the substrate, and whose faces are covered with conductive material as claimed by Applicants.

Thus, the Examiner attempts to cure the deficiencies of Inoue by turning to the disclosure of Nakamura. According to figure 1, and col. 6, lines 4-19, Nakamura discloses a second group of through holes (23) which are provided in electrodes of the semiconductor element (3), pass from a surface through the backside of the substrate (20), and whose faces are covered with conductive material (24). However, Nakamura merely discloses that side faces of the through holes are covered with a metal film or layer, but fails to disclose the features of making the distance between two adjacent through holes small so as to improve isolation between two adjacent semiconductor elements.

Further, neither Inoue nor Nakamura disclose through holes for shielding and through holes for electrodes of a semiconductor device, as claimed. Consequently, it cannot be said that Inoue and Nakamura, taken alone or in combination, teach or suggest the features of simultaneously forming a first group of through holes and a second group of through holes, as presently claimed.

The Examiner has failed to establish a *prima facie* case of obviousness for at least four reasons. First, the Examiner has not demonstrated how Inoue and Nakamura, whether taken alone or in combination, disclose or suggest each and every feature recited in the claims. See M.P.E.P. § 2143 (7th ed. 1998). Second, the Examiner has not shown the existence of any reasonable probability of success in modifying Inoue, the base reference, based on the teachings of Nakamura, the secondary reference, in a manner that could somehow result in the claimed invention. See id. Third, the Examiner has not identified any suggestion or motivation, either in the teachings of the applied references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the apparatus of Inoue in a manner that could somehow result in the claimed invention. See id. Finally, the Examiner has not explained how his obviousness rationale could be found in the prior art — rather than being a hindsight reconstruction of Applicants' own disclosure. See id.

Dependent claims 16 and 18-21

Claims 16 and 18-21depend from claim 15, and therefore include the combinations the features set forth in their respective independent claims. For at least this reason, the rejection of these dependent claims also should be reversed. Additionally, the dependent claims recite combinations of features including additional subject matter not taught or suggested by Inoue and Nakamura. For instance, it should be noted that claims 20 and 21 recite, among other things, the feature of downsizing an RF device by connecting elements of the RF device to a wiring layer. Neither Inoue nor Nakamura disclose this feature. Thus, it cannot be said that Inoue and Nakamura, taken alone or in combination, teach or suggest the feature of downsizing an RF device by connecting elements of the RF device to a wiring layer, as presently claimed. However, because the distinctions pointed out above are clear, Appellants will not belabor at this time a detailed discussion of separately patentable subject matter set forth in the dependent claims. Thus, the cited prior art combination fails to disclose each of the claimed elements of the invention.

In accordance with the M.P.E.P. § 2143.03, to establish a *prima facie* case of obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. In re Royka, 409 F.2d 981, 180 USPQ 580 (CCPA 1974). "All words in a

claim must be considered in judging the patentability of that claim against the prior art." In re Wilson, 424 F.2d 1382, 1385, 165 USPQ 196 (CCPA 1970). Therefore, it is respectfully submitted that neither Inoue nor Nakamura, taken alone or in any proper combination, discloses or suggests the subject matter as recited in claims 11 and 15. Hence, withdrawal of the rejection is respectfully requested.

Each of the dependent claims depend from one of independent claims 11 and 15 and are patentable over the cited prior art for at least the same reasons as set forth above with respect to claims 11 and 15. For example, regarding claims 12-14 and 16-21, Inoue and Nakamura fail to disclose or fairly suggest the invention as recited in independent claims 11 and 15 as outlined above.

In addition, each of the dependent claims also recite combinations that are separately patentable.

VIII. CONCLUSION

Since the Examiner's final rejections under 35 U.S.C. § 103(a) are inappropriate for the reasons set forth above, Appellants respectfully request the Board to reverse each ground of the rejections.

Respectfully submitted,
Nixon Peabody LLP

Date: June 19, 2008

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IX. CLAIMS APPENDIX

11. An RF device comprising:

a plurality of semiconductor elements formed on a semiconductor substrate composed of a semiconductor material;

a plurality of through holes which are provided between two adjacent ones of the plurality of semiconductor elements and pass from a surface through the backside of the semiconductor substrate,

wherein a distance between two adjacent ones of the plurality of through holes is smaller than a thickness of the semiconductor substrate so as to reduce power leaking between two adjacent ones of the plurality of semiconductor elements.

12. The device of claim 11, wherein side faces of the plurality of through holes are covered with a conductive material.

13. The device of claim 12, wherein the conductive material is electrically connected to a ground wiring layer provided on the surface of the backside of the semiconductor substrate.

14. The device of claim 11, wherein the semiconductor substrate is a GaAs substrate.

15. An RF device comprising:

a plurality of semiconductor elements formed on a semiconductor substrate composed of a semiconductor material;

a first group of through holes which are provided between two adjacent ones of the plurality of semiconductor elements and pass from a surface through the backside of the semiconductor substrate and whose side faces are covered with a conductive material; and

a second group of through holes which are provided in electrodes of the plurality of semiconductor elements, pass from a surface through the backside of the semiconductor substrate, and whose side faces are covered with the conductive material,

wherein the conductive material which covers side faces of the first and second groups of through holes is electrically connected to a first wiring layer provided on the backside of the semiconductor substrate, and

a distance between two adjacent ones of the first group of through holes is smaller than a thickness of the semiconductor substrate so as to reduce power leaking between two adjacent ones of the plurality of semiconductor elements.

16. The device of claim 15, wherein the semiconductor substrate is a GaAs substrate.

17. The RF device of claim 11,

wherein the distance between two adjacent ones of the plurality of through holes is smaller than a thickness of the semiconductor substrate so as to exponentially reduce power leaking between two adjacent ones of the plurality of semiconductor elements with regard to the distance between two adjacent ones of the plurality of through holes.

18. The RF device of claim 15,

wherein the distance between two adjacent ones of the first group of through holes is smaller than a thickness of the semiconductor substrate so as to exponentially reduce power leaking between two adjacent ones of the plurality of semiconductor elements with regard to the distance between two adjacent ones of the first group of through holes.

19. The RF device of claim 15,

wherein some through holes of the first group and some through holes of the second group are electrically connected to the first wiring layer, and

some of the other through holes of the first group and some of the other through holes of the second group are electrically connected to a second wiring layer.

20. The RF device of claim 19,

wherein a grounded wiring layer is formed on a printed circuit board, and

the first and second wiring layers are electrically connected to the grounded wiring layer.

21. The RF device of claim 20,

wherein a third wiring layer other than the grounded wiring layer is formed on the printed circuit board, and

one of the through holes of the second group is electrically connected to the third wiring layer.

X. EVIDENCE APPENDIX

There is no related evidence to submit at this time.

XI. RELATED PROCEEDINGS APPENDIX

There are no related proceedings to this Appeal.